MS-TW/THW Programmers Guide.



Feb.15, 2006

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 1 of 18

General:

The MS-TW/MS-THW sensor uses an augmented DS2438 chipset. The two models are exactly the same except the MS-THW has a Honeywell humidity sensor.

The Temperature and Humidity measurements are exactly the same as the MS-T and MS-TH sensors. See the MS-T/MS-TH manual for programming instructions.

All the documented DS2438 commands are present and performed by the Dallas part of the chip set.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 2 of 18

Using the MS-TW/THW with LinkTH

The MS-TW/THW is supported by the LinkTH ASCII interface.

The MS-TW reports itself as sensor type 0x1D and the MS-THW as sensor type 0x1E. No 1-Wire programming is necessary to use the MS-TW/THW with the LinkTH.

Example response of a MS-TW without a cable plugged in and Debug Knob 08 on:

26E3D96D00000B1 1D, 23. 68, 74. 56, 1, 0, 010F0051009000590063 EOD

Example response of a MS-TW with the cable plugged in:

26E3D96D00000B1 1D, 23. 90, 74. 96, 0, 0, 004C035100900059000C EOD

Example response of the same MS-TW with the cable plugged in and wet:

26E3D96D00000B1 1D, 23. 62, 74. 43, 0, 1, 024103EA0090005900DE EOD

- 1. The DS2438 serial number and sensor type (**26E3D96D00000B1 1D**)
- 2. The temperature reading in degrees C (23. 62)
- 3. The temperature reading in degrees F (74. 43)
- 4. Continuity check results (**0**) ... Continuity good
- 5. Water detection check results (1) ... Cable reads above threshold
- 6. Contents of the WD registers as 9 bytes of data + CRC (024103EA0090005900DE)

The Water Detection results is **0x02** (good continuity, cable wet) The Continuity Test result was **0x0341** The Water Detection result was **0x00EA** (Higher than threshold) The current Threshold is **0x0090** The Detection floor is **0x0059** The CRC of the data is **0xDE**

> Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 3 of 18

Augmented commands

Augmented commands (which begin with a command code of 0x00) are provided by the iButtonLink augmentation processor. The Augmentation processor is configured at the factory with the same serial number as the DS2438 on the MS-TW/THW. It appears to the 1-Wire bus as a single DS2438 with an extended command set.



Block Diagram of MS-TW/THW (Super2438)

Features added by the MS-TW/MS-THW chip set:

256 bytes of additional EEPROM (16 bytes reserved for MS-TW/THW)16 bytes of SRAM scratchpad memory.Commands to monitor, report, and calibrate the sensing cable.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 4 of 18

Augmented Memory visible to user

WDRegister:

Size	Description
Byte	WD status
	Bit $0 = 0$ Voltage was not above detection threshold (dry)
	1 Reading was above detection threshold (wet)
	Bit $1 = 0$ Cable continuity test passed
	1 Cable continuity test failed
Word	WDContinuity reading (Average of 8 conversions)
Word	WDDetection reading (Average of 8 conversions)
Word	Detection Threshold
Word	Detection Floor

Scratchpad:

Size	Description
Byte(16)	User data initialized to 0x00 at power up

EEPROM

Byte(112)	User memory
Byte(16)	Protected Configuration Memory

The protected Configuration Memory can be read but can not be changed with CopyScratchpad

The protected memory contains:

Byte(8)	Serial Number of Augmentation processor
Word	Persistent WD Floor value
Word	Persistent WD Threshold value
Word	Unused (reserved)
Word	Unused (reserved)

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 5 of 18

The MS-TW/THW augmented command set:

0x00 Command Augmentation Preamble
0x0001 Report software version
0x0002 Lock the Serial Number
0x0003 Read the contents of the WD registers (Returns up to 10 bytes)
0x0004 Set the WD Threshold and WDFloor Registers (receives 4 bytes)
0x0005 Save the WD Threshold and WDFloor Registers to EEPROM
0x0008 Read EEPROM data (User specifies start address)
0x0011 Load new 2438 serial number into persistent store
0x00B4 Convert Voltage (Causes Water Detection test to execute)
0x00BE Read Scratchpad (Returns up to 9 bytes)
0x004E Write Scratchpad (Receives 1 byte EEPROM address)
0x00B8 Recall Memory to Scratchpad (Receives 1 byte EEPROM address)

General observations :

The Super2438 augmentation processor does not emit a presence pulse. It is programmed at the factory with the same serial number of its companion DS2438. The serial number can not be changed after the Super2438 leaves the factory. The detection floor and detection threshold have been set at the factory. The detection floor is set to the no cable reading of the sensor. The detection threshold is set to the detection floor + 55 ticks.

> Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 6 of 18

0x0001 Report Software Version

The report software version command returns a single byte of information

The high nibble is the major software Version Number

The low nibble is the minor software Version Number

Example: (Only one MS-TW or MS-THW on the bus)

bCC0001FF<CR> will return

CC000112

So the Major Software number is 1 and the Minor Revision Number is 2

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 7 of 18

0x0002 Lock the Serial Number

The Serial Number Lock command has been executed at the factory during manufacturing. There is no unlock capability

The command is a write once command and has no effect after the MS-TW/THW leaves the factory.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 8 of 18

0x0003 Read the contents of the WD registers.

Read WD registers returns up to 10 bytes of data (9 data bytes + 1 CRC8 byte)

It is recommended that you read all 10 bytes and check the CRC8 to insure that the data transmission was without error.

Example: (Only one MS-TW or MS-THW on the bus)

returns:

bCC0003ttuuUUvvVVxxXXyyYYzz<CrLf>

where

tt is the WD status register uu is the LSB of the Continuity Check Register UU is the MSB of the Continuity Check Register vv is the LSB of the Detection Reading Register VV is the MSB of the Detection Reading Register xx is the LSB of the Detection Threshold Register XX is the MSB of the Detection Threshold Register yy is the LSB of the Detection Floor Register YY is the LSB of the Detection Floor Register zz is the CRC8 of ttuuUUvvVVxxXXyyYYzz

Note: The read can be terminated at any time, however, if the full 10 bytes are not read, please check that the WD status register is NOT 0xFF. Since the upper bits CANNOT be 1's, a 0xFF would indicate that the address select was not successful and the data in the lower two bits is meaningless.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 9 of 18

0x0004 Set the WD Threshold and WDFloor Registers

The Set Threshold and Floor Registers command is used to calibrate the MS-TW/MS-THW detection algorithm. This command changes the volatile (RAM) copy of the registers. If the MS-TW or MS-THW is power cycled, the values will revert to the persistent settings stored in EEPROM.

Example: (Only one MS-TW or MS-THW on the bus)

bCC0004xxXXyyYY<cr>

where:

xxXX is the Detection Threshold register setting yyYY is the Detection Floor setting

Note: yy is the LSB of the Threshold Register and YY is the MSB of the Threshold Register xx is the LSB of the Floor Setting and XX is the MSB of the Floor Setting

Related commands:

0x0005 Save the WD Threshold and WDFloor Registers to EEPROM

Suggested calibration sequence:

- 1. Determine the register settings desired.
- 2. Use the 0x0004 command to change the volatile settings
- 3. Read the volatile settings back using the 0x0003 command
- 4. If the settings are as expected, use the 0x0005 command to update the persistent copy of the registers in EEPROM
- 5. Read the EEPROM location to ensure the persistant settings were written correctly.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 10 of 18

0x0005 Save the WD Threshold and WDFloor Registers to EEPROM

This command copies the volatile WD Threshold and WD Floor Registers to EEPROM.

The command has no arguments.

While the copy is in progress, the MS-TW/MS-TWH will emit 1's. When the write is complete the MS-TW will start to emit zeroes. The 1-Wire bus can then be reset. Alternatively, the write will take 20ms to complete.

Example: (Only one MS-TW or MS-THW on the bus)

bCC0005<Cr>

Wait 20ms

r

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 11 of 18

0x0008 Read EEPROM data (User specifies start address)

The Read EEPROM command can read the entire contents of the persistent store (EEPROM) of the augmentation processor.

It takes a single byte (beginning address) as the only input argument. The range of the argument is 0x00 through 0x7F. The Read EEPROM command will wrap from address 0x7F to address 0x00.

This is the only command which can read the "protected" EEPROM addresses containing the Serial Number and persistent storage for WD Threshold and WD Floor.

Example1: (Only one MS-TW or MS-THW on the bus)

This command would return the contents of location $0 \\ x 00$ through $0 \\ x 04$ of the <code>EEPROM</code>

Example1: (Only one MS-TW or MS-THW on the bus)

bCC00086EFFFFFFFFFFFFFFFFF

This command would return the contents of location 0x6E, 0x6F, 0x00, 0x01, and 0x02 of the EEPROM (note the address wrap).

Note:

The Read EEPROM command returns the data directly. If the programmer wishes to validate the integrity of the data returned, use the Recall Memory command followed by the Read Scratchpad command. Since the Read Scratchpad command appends a CRC after the data returned, the programmer can check that CRC to validate the data payload.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 12 of 18

0x0011 Load new 2438 serial number into persistent storage

This command is disabled before the MS-TW/THW is shipped.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 13 of 18

Ox00B4 Convert Voltage (Causes Water Detection test to execute)

The augmentation processor will also respond to a standard 0xB4 command to the DS2438 and execute the Water Detection test to execute.

The continuity lines are read 8 times and the average is placed in the Continuity Reading Register.

The detection lines are read 8 times and the average is placed in the Detection Reading Register.

The augmentation processor will emit 1's during the conversion and 0's after the detection test is complete.

The WD Status register is updated by the 0x00B4 or 0xB4 command.

The continuity bit is set to zero if the average reading of the continuity lines was greater than xxxx. Otherwise, the continuity bit is set to 1 (continuity failed).

The detection bit is set to zero (0) if the average reading of the detection wires was less than or equal to the WDThreshold Register. If the average reading was greater than WDThreshold, the detection bit is set to one (1).

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 14 of 18

Ox00BE Read Scratchpad (Returns up to 17 bytes)

The Read Scratchpad command is used to retrieve the contents of the 16 byte Scratchpad area. The Read can be terminated at any point, however, it is recommended that the user read all 17 bytes. The first 16 bytes are data and the 17th byte is a CRC-8 of the data payload.

For the best results, once data has been written to the scratchpad, the Read Scratchpad command should be used to verify that the payload of the WRITE SCRATCHPAD was received correctly by the MS-TW/THW.

This is especially true if the next step of the users program is to issued a copy scratchpad to EEPROM.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 15 of 18

Ox004E Write Scratchpad (Receives up to 16 bytes)

The Write Scratchpad command is used to change the contents of the SRAM scratchpad area of the MS-TW/THW. Note that the scratchpad area is volatile and will be lost on power loss.

The Write Scratchpad command receives up to 16 bytes of data and replaces the data in the scratchpad one for one. The replacement always begins at byte 1 of 16.

If you only need to change the first few bytes of the scratchpad, the Write Scratchpad command can be terminated by a 1-Wire reset at any point.

Since no data validity checking is done on the inbound data, best practices dictates that a Read Scratchpad command be executed after the Write Scratchpad to verify the contents of the scratchpad area.

This is especially important if the next command will be a Copy Scratchpad to EEPROM.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 16 of 18

0x0048 Copy Scratchpad (Receives 1 byte EEPROM address)

The Copy Scratchpad command moves 16 bytes of data from the scratchpad to the persistent store (EEPROM). The command has a single argument, that being the beginning address in EEPROM for the copy. The beginning address has a range of 0x00 to 0x6F. The Copy Scratchpad will wrap around from 0x6F to 0x00 during a copy.

The MS-TW/THW will emit 1's during a Copy Scratchpad operation. Once the copy is complete, the MS-TW/THW will begin to emit 0's. Alternatively, the user may wait 80ms (worst case) for the copy to complete.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 17 of 18

0x00B8 Recall Memory to Scratchpad (Receives 1 byte EEPROM address)

The recall Memory to Scratchpad retrieves 16 bytes of EEPROM memory and places it in the Scratchpad Register.

The user supplies a single byte as the argument to the 0x00B8 command. That byte specifies the beginning address in EEPROM for the recall. The beginning address has a range of 0x00 through 0x6F. The Recall Memory command will wrap addresses from 0x6F to 0x00 during a recall.

Copyright 2006 iButtonLink LLC All rights reserved 2/8/2006 3:13:48 PM Page 18 of 18